

Course Outcomes

1. Analyse the effect of support on the performance of a catalyst for a specific reaction
2. Understand the different techniques of catalyst preparation and evaluate the choice of the preparation method for an application
3. Distinguish the different types of adsorption and evaluate the adsorption parameters from the experimental data
4. Discriminate and Compare different catalyst characterization techniques and assess their capabilities on the catalyst performance.

Syllabus

Introduction to Catalysis: Types of Heterogeneous catalysts – supported and unsupported catalysts, advantages and disadvantages;

Properties of catalyst supports – particle size, pore size, pore size distribution, surface area, acidity of the catalyst;

Catalyst Preparation techniques – wetness impregnation, precipitation and coprecipitation, solgel technique, drying, calcination and reduction; effect of support properties during catalyst reduction– discussion on the application of reduced catalysts for hydrogen and fuel production, petroleum refining etc.; Catalyst promoters and inhibitors;

Kinetics of Heterogeneous Catalysis: Adsorption in solid catalysts – Types of adsorption; single and multilayer adsorption, kinetics of adsorption; reaction mechanics

Catalyst Characterization – Structural Analysis – BET Surface area; Pore analysis using BJH method and mercury intrusion method; Temperature Programmed Techniques – TPD, TPR, TPO, TPX, TGA and DTA – Dispersion, turnover frequency, acidity of the catalyst and loss on ignition; X-Ray Diffraction (XRD) Analysis; XPS Analysis

Different Types and Catalysts and Their Applications – zeolite catalysts, polymerization catalysts, Phase Transfer catalysts;

Text and Reference Books

1. G. Ertl, H. Knozinger and J. Weitkamp, "Handbook of Heterogeneous Catalysis" Vol 1-5, Wiley – VCH, 2008
2. B. Viswanathan, S. Sivasanker, A.V. Ramaswamy, "Catalysis : Principles & Applications" CRC Press, 2002
3. J. M. Thomas and W. J. Thomas, "Principles and Practice of Heterogeneous Catalysis", Wiley-VCH
4. Jens K. Norskov, Felix Studt, Frank Abild-Pedersen, Thomas Bligaard, Fundamental Concepts In Heterogeneous Catalysis, John Wiley & Sons Inc, 2014

Evaluation Pattern

MidTerm Exam – 30%

Course Project Synthesis and Characterization of any one catalyst of their choice – 10%

Quizzes / Assignments – 10%

End Semester Exam – 50%